PCF Elettronica's
MOD. 110H - ENV

TOTAL VOLATILE ORGANIC COMPOUNDS
(T.V.O.C., or T.O.C. or S.O.V.)
MONITOR

Showing a very high speed response time

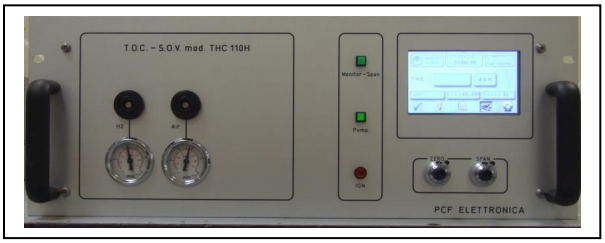
Operating Manual

(Preliminary release, October 18th, 2016 updated February 10th 2017)

Contents: Page

1.0 FOREWORDS

VOLATILE ORGANIC COMPOUNDS (V.O.C.)
MONITOR
MOD. 110H - ENV



The FID detector is generally known as the most linear and stable sensor for detection of organic compounds. Particularly in environmental monitoring, where a mix of hydrocarbons are present in the sample, the measuring equipment requires a detector possibly equally sensitive to all types of compound. For this matter the FID is the detector that mostly meets the requirements.
Mod. 110H - ENV Hot FID VOC monitor has been studied, developed and manufactured to monitor the Total Volatile Organic Carbon (TVOC) and eventually the Methane fraction (CH_4) at emissions and/or environment.
The methane fraction separation, in a special version, is carried out through an hot scrubber column, while carbon compounds are detected in a specially developed Flame Ionisation Detector (FID detector).
PCF Elettronica's FID detector is very well known for its stability as well as for its low maintenance in the time.

Please note: Mod. 110H - ENV is usually sold with different configurations:

1- **Mod. 110H - ENV is the environment version of the most popular Mod. 110H, intended for environment monitoring of VOCs.**
2- Stripped configuration, the most frequent one with no options
3- Configurations with built in zero air generator and/or separation mode for CH_4 fraction and/or with digital Line/Data Logger.

In the following operating manual no difference is made between different versions of Mod. 110H - ENV VOC monitor.

2.0 WORKING PRINCIPLE

PCF's Mod. THC 110 ENV Volatile Organic Compounds (V.O.C.) monitor, was studied, developed and manufactured prescriptions and regulations intended to detect the total amount of volatile hydrocarbons at emissions.
The instrument is fully automated and thanks to its special design it can operate within a wide temperature and humidity range with no influence in the reproducibility and stability of measurements in the applications.
A second glass wool filter is located for protection in front of the sample capillary.
Gas sample is continuously fed to FID (Flame Ionisation) detector, as to have a continuous and very fast response with no delay due to sampling valve and loop filling.
Gas sample route from tip of sampling probe down to the detector is kept at a controlled high temperature in order to avoid any condensation whatsoever as well as sample loss.

Description of measuring principle of an FID detector
An hydrogen micro flame may be employed as specific detector of organic compounds as the reaction of carbon oxidation, that takes place in it, generate a consistent quantity of ions.
The actual configuration of the detector foresees the mixing of hydrogen with the sample gas; the combustible mixture is then burnt at the extremity of a very small nozzle in oxygen excess (pure air in great stoichiometric excess).
The electrical charges generated by the combustion of organic compounds within the sample are collected by a couple of metallic electrodes and successively converted electrical currents.
The ionisation currents fed to an electrometer generate at the output voltages proportional to the ion currents in the flame and in last instance proportional to carbon content within the sample.
Flame ionisation variations therefore correspond to voltage variations at the electrometer output that may be successively fed to data management and acquisition electronics.

Thanks to the high versatility and flexibility of the measuring system it's easily extended, with suitable extension of sampling and data management devices, to multi-point monitoring both at emission and industrial applications.

The FID detector is generally known as the most linear and stable sensor for detection of organic compounds. Particularly in emission monitoring, where a mix of hydrocarbons could be present in the sample, the measuring equipment requires a detector possibly equally sensitive to all types of compound. For this matter the FID is the detector that mostly meets the needs.
PCF Elettronica's FID detector is very well known for its stability as well as for its low maintenance in the time.

It's generally known that organic compounds in hydrogen flame ionise, generating a quantity of carbon - ions nearly proportional to their content in the compound itself. The quantity of carbon ions generated is proportional to the total quantity of carbon passing through the hydrogen flame, i.e. concentration of carbon compounds multiplied by their carbon atoms.

The carbon (methane) equivalent concept (further information on the enclosed APPENDIX 1).
In the environment there is very high number of different organic compounds so the response of the instrument detector cannot be referred to a single compound. The measurements must be considered in terms of equivalent response, .i.e. the response of the detector is "normalised" (referred to) to a single compound.
The characteristics of FID detector, i.e approximately proportional to organic carbon concentration in the sample, makes the purpose easy. At first approximation the same concentration in air of compounds with different carbon atom number responds proportionally to the number of atoms in the molecule, so:

Concentration p.p.m.	Species	FID ≈ response
1	CH_4	1
1	C_2H_6	2
1	C_3H_8	3
1	C_6H_{14}	6
1	C_6H_6	6

In other words, once the instrument response is normalised to methane, 1 ppm of propane will approximately generate a signal as 3 ppm of methane equivalent or carbon equivalent.
Therefore for 1 ppm of Benzene, the equivalent methane concentration is ≈6 ppm.
As a simple rule to calculate the methane (carbon) equivalent in the sample:

concentration (ppm) x number of carbon in the molecule

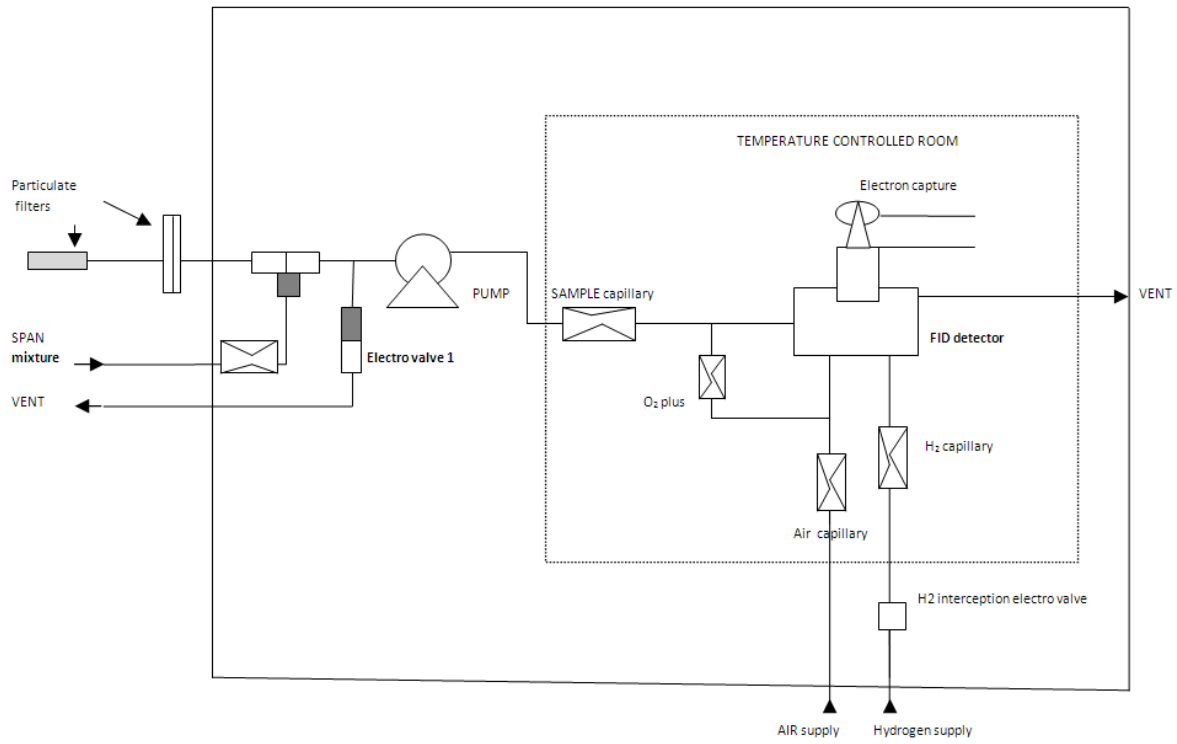
e.g. a concentration of 20 ppm of propane gives: 20 ppm x 3 ≈60 ppm equivalent of methane (or carbon).

Data shown on digital display are available to be either memorised or managed as follows:

- Continuous recording on a strip chart recorder through a 0-1Vdc or 4-20mA analogue output.
- Digital recording thorough a USB output, e.g. on a digital PEN.
- Displayed in real time as VOC concentration at emission.

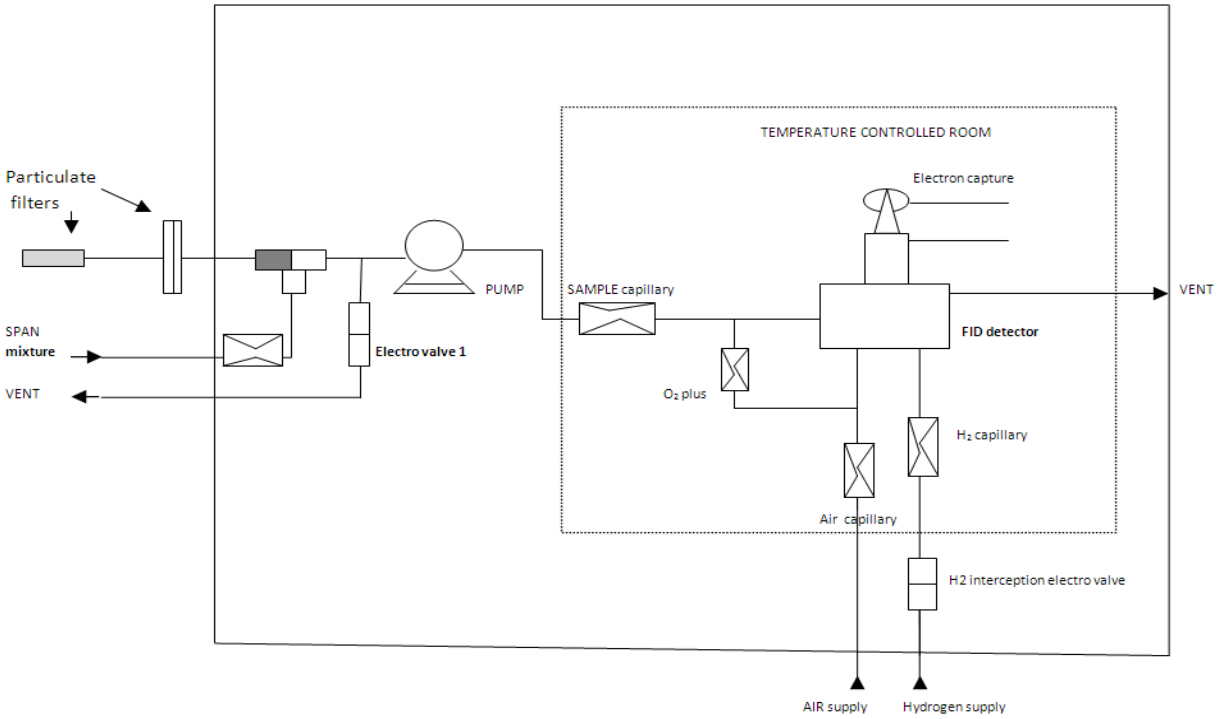
Mod. 110H - ENV, VOC monitor: "WORKING GENERAL SCHEMATICS"

A) The instrument in the working mode: “MONITORING”



Please note:
i) Hydrogen must be supplied at 2.5 - 3 Bar, regulate the relevant pressure regulator on fron panel at the tagged value
ii)) Pure air must be supplied at 2.5 - 3 Bar, regulate the relevant pressure regulator on front panel at the tagged value.
iii) Calibration mixture must be supplied ar 2.5 Bar.

B) The instrument in the calibration mode: “CAL”



Please note:

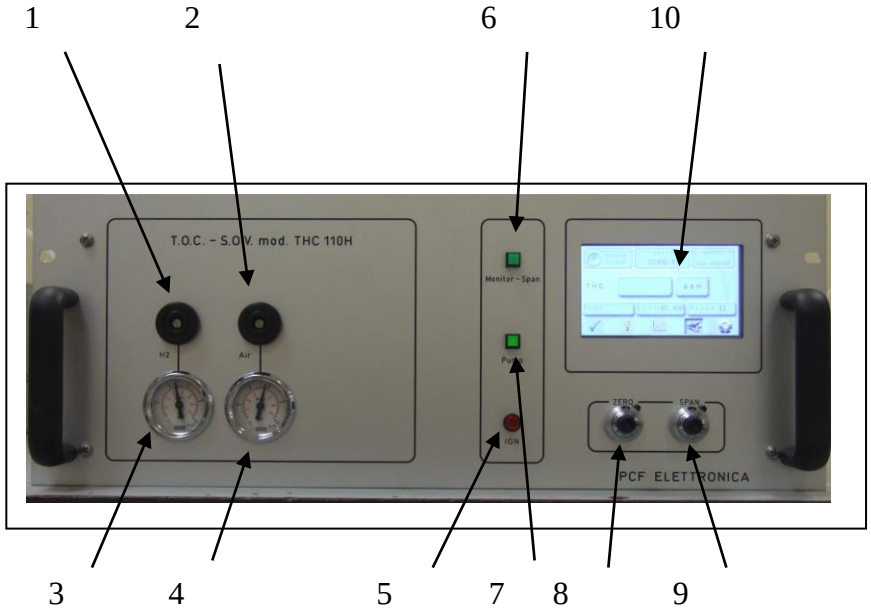
1- In the supplied configuration the instrument is intended to perform the calibration with compressed gas cylinder mixture, supplied pressure 2.5 Bar.
2- If you calibrate with a multi point calibrator, atmospheric pressure you must keep electro-valve 1 always closed.

3.0 TECHNICAL SPECIFICATIONS

- Detector : Hot Flame Ionisation Detector
- Measuring ranges (3) : 0-10/100/1000 ppm or mg/Nm^3
  With the selection of 0/4-20 mA the voltage output can be configured for 0-5/50/500 ppm or mg/Nm^3
  (other ranges available on request)
- Methane fraction separation (**as option**) : by manual insertion of deviation valve
- Background noise : 0.2% full scale
- Lower Detectable Limit (LDL) : 0.4% full scale
- Precision : ± 1% full scale
- Linearity : ± 1% full scale
- Zero stability (24 hours) : ± 0.5% full scale
- Zero drift against environment Temp. : ± 1% full scale every 10°C of environment temperature variation
- Span stability (24 hours) : ± 1% full scale
- Span drift against environment Temp. : ± 1% full scale every 10°C of environment temperature variation
- Rise time : 1 second to 98% of full scale
- Response time : according to sampling line length
- Sample flow rate : 1,000 – 1,800 ml/min
- Sample circuit temperature : 180 °C
- Operating temperature range : 5 – 40 °C
- Zero/Span check : set from front panel and/or remote
- Display : 5.5” colour TFT – LCD touch screen
- Alarms : high concentration value (full scale %)
  Flame OUT
  Temperature
- Alarm on set value : no tension free SPDT for each channel
- Instrument controls : from front panel

- Automatic hydrogen interception : in case of FLAME OUT conditions
- Analogue outputs : 0-1 Vdc or 4-20 mA (selectable)
- Serial and digital outputs : RS 232 (9 pin connector)
  (USB optional)
  SPDT contacts (Ethernet optional)
- Services required Hydrogen : 28 ml/min,
  Pure Air : 300 ml/min
- Suggested calibration gas cylinder : we suggest to calibrate with a concentrations within 20-60% of the measuring range.
  Usually we calibrate in terms of C/CH_4 ppm or mg/Nm^3.
  Please remember that calibration mixture must have **air balance**.
  Also remember that FID is a Carbon Counter therefore 1 ppm of Propane generates a signal 3 times that of Methane signal.
- Mounting : standard 19" rack
- Dimensions: : 480x250x560 mm (18.9"x9.9"x22.22" WxHxD), 4U
- Weight : 9 Kg
- Standard power supply : 220/110 Vac 50/60 Hz (to be specified in order)
- Power consumption : up to 500 VA, in the warm-up phase (heat traced line excluded)
- Heat traced line : 80 W/m
- Pneumatic connections : 1/4" or 4/6 mm and 1/2 mm

4.0 FRONT PANEL VIEW



New Mod. 110H - ENV VOC monitor (front panel view)

Figure captions

1 – FID H_2 supply pressure gauge

2 – FID H_2 supply pressure regulator

3 – FID Air supply pressure gauge (refer to the UPP Zero Air Supply)

4 – FID Air supply pressure regulator (refer to the UPP Zero Air Supply)

5 – FID flame ignition lighting switch, when the **light is ON** the FID is off.

6 – MONITOR/SPAN mode switch, with light OFF the instrument is in "**MONITOR** mode", when light ON the instrument is in "**SPAN** mode".

7 – Sampling pump activation switch, when **pump is ON** the light is on.

8 – ZERO trimming potentiometer

9 – SPAN regulation potentiometer

10 – Colour DISPLAY (touch screen), VOC indicated as ppm

5.0 DESCRIPTION OF FRONT PANEL CONTROLS

1- Hydrogen pressure gauge (1) active when flame is ON, when flame is OFF the hydrogen interception valve will not allow pressure on the gauge.

2- H_2 pressure regulator (2), it regulates the hydrogen quantity delivered to flame detector, as combustible gas.

3- Air pressure gauge (3), the air is the supporter of combustion in FID detector.

4- Air pressure regulator (4), it regulates the Air quantity delivered to FID detector as flame combustion supporter.

5- Auto-Return lighting switch (5), for the ignition of FID detector micro flame, it also indicates the micro flame status (light ON indicates that the FID micro flame is OFF).

6- MONITOR/SPAN lighting switch (6).
The **MONITOR** status (light OFF) is selected for the normal operating conditions of the instrument.
While the **SPAN** status (light ON) is normally selected for either the calibration check or the full calibration operations.

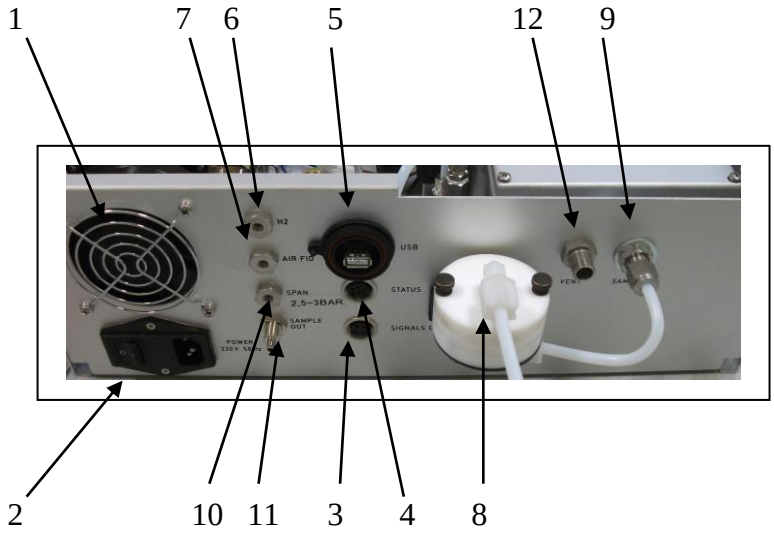
7- Sample pump activation lighting switch (7); it switches ON (light ON) and OFF the relevant pump. The heated head sampling pump must be switched ON only when the head reached set temperature value(some 20' after switching On the cold instrument.

8- Potentiometer (8) allows manual zeroing of the FID output signal base line.

9- Potentiometer (9), for system full range sensitivity adjustment (SPAN).

10- Touch screen colour graphic display (1), for direct digital display of VOC content (ppm) in the analysed sample, measured by FID.

6.0 REAR PANEL VIEW



New Mod. 110H - ENV VOC monitor (rear view)

1- Instrument cooling fan.

2- POWER SUPPLY 220 V 50Hz (110 Vac 60 Hz on request): mains power supply socket.

3- SIGNAL OUTPUTS connector: analogue signals output connector.

4- STATUS connector: status and alarm contacts output connector.

5- USB connector

6- H_2 IN: pneumatic connection for the FID detector Hydrogen supply.

7- FID AIR IN: pneumatic connection for the FID detector Air supply.

8- TEFLON filter on the sample intake.

9- SAMPLE IN: pneumatic connection for SAMPLE IN.

10- SPAN, Pneumatic connection for SPAN gas.

11- SAMPLE OUT

12- VENT: pneumatic connection for SAMPLE OUT (VENT), not in use.

7.0 DESCRIPTION OF REAR PANEL CONNECTIONS

1- Cooling fan (1) for keeping electronic circuits at environmental temperature.

2- Connection socket (2) to the mains power line (220/110 Vac, 50/60 Hz, specify when ordering) for powering the instrument.

3- Output socket of digital status signals (3) for flame OFF, temperature alarm and high concentration alarm (other control status available as OPTION).

4- On this socket (4) the 0-1 Vdc and 4-20 mA measurements analogue signals are available for peripheral data acquisition units connection.

5- USB connector, suitable for a digital PEN.

6- To this pneumatic connector (6) is plumbed the FID hydrogen supply, either from gas cylinder or hydrogen generator.

7- To this pneumatic connector (7) is plumbed the gas chromatographic air supply, either from gas cylinder or UPP air generator (e.g. PCF's Mod. 9588 UPP Zero Air Generator). If the instrument is intended to measure high concentrations (>100 ppm), a simple clean air passed though carbon filters and molecular sieves may be used.

8- TEFLON filter on the sample intake.

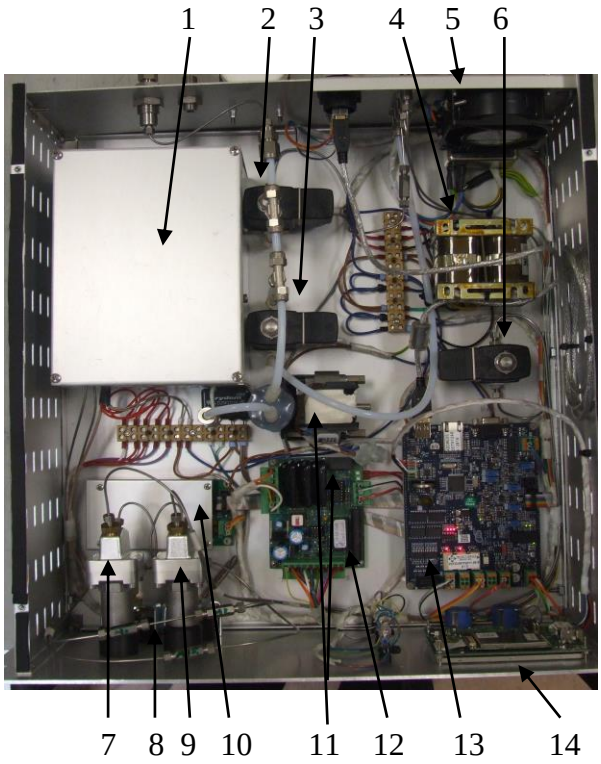
9- To this pneumatic connection (9) the filtered sample line is connected.

10- CALIBRATION GAS PORT, to this pneumatic connector (10) is plumbed the calibration gas mixture from a traceable gas cylinder. Standard sample must be introduces at very low pressure, better if under vent conditions (Optional).

11- To this pneumatic connector (11) must be plumbed the tubing to take the sample out of the rack.

12- Not in use in this version of the instrument.

8.0 TOP VIEWS



Top view with closed Temperature Controlled Room

Top view of the Temperature Controlled Room

Figure captions:

1- Temperature controlled (T.C.) room.
2- Sample/Calibration three way electro valve.
3- Vent electro valve.
4- Mains trafo.
5- Air cooling fan.
6- Hydrogen interception electro valve.
7- Hydrogen pressure regulator body
8- Hydrogen capillary.
9- Air pressure regulator body.
10- Electrometer PCB module (with cover sheet to avoid electrical interferences).
11- Sampling room temperature pump.
12- Auxiliary PCB board (multi service board).
13- Main PCB board.
14- Video display PCB board (touch screen).
15- Air capillary.
16- Sample capillary.
17- Sample vent capillary.
18- FID detector.

PCB description

the instrument incorporates just three Printed Circuit Boards (PCB):
MULTI SERVICE PCB (MS PCB)
ELECTROMETER PCB module
DIGITAL DISPLAY AND MAIN PCB

MULTI SERVICE PCB (MS PCB) function description
The MS PCB controls:

- temperature of FID detector
- temperature of thermostatic room
  Proportional thermo-regulators keep at constant temperature both analytical chamber and the FID detector.
  The working temperature changes according analytical applications, the stability of the temperature control is within ±0.5 °C.
  The temperature control is carried out by a PT 100 sensor.
  The set point is fixed by a trimmer located on the same PCB.
- automatic flame ignition of FID
- flame ON/OFF conditions/Alarms by digital signal.
- the hydrogen interception solenoid valve control circuit
- the high voltage (300 Vdc) stabilised power supply, to excite the detector ionic field.

ELECTROMETER PCB function description

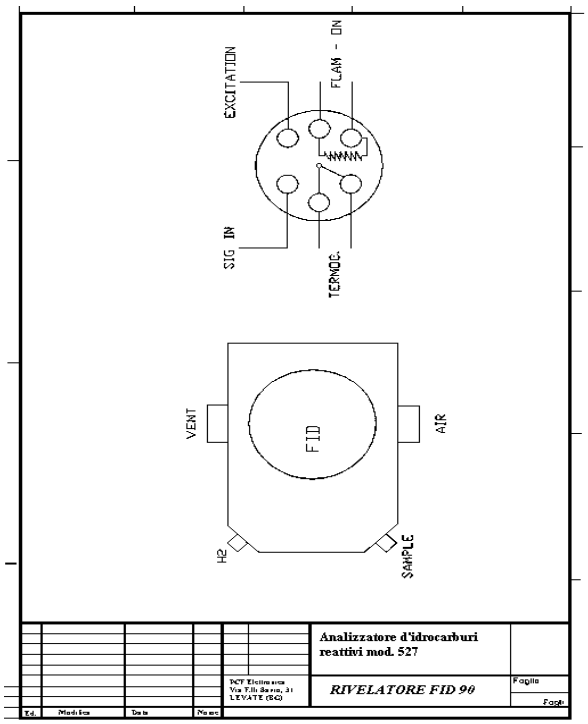
- The detector output signal is very low, a few pA of ionisation current, therefore this signal must be AMPLIFIED by a suitable sophisticated electronic circuit. On this PCB are located all elements for this purpose.

DIGITAL DISPLAY AND MAIN PCB function description
This PCB carries:

- the two-line Digital Display,
- the micro processor unit that manages logics and operations of full instrument
- analogue output signal electronics.

9.0 FLAME IONISATION DETECTOR (FID)

(The internationally recognized detect for Total VOC monitoring at stacks)



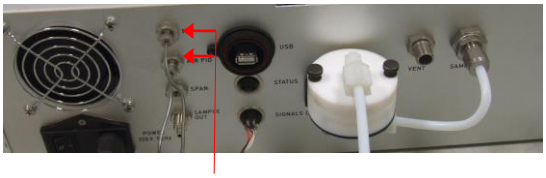
The FID is the core of Model THC 110 Hot FID detector.
It shows a central nozzle that receives through a capillary hydrogen, about 25 ml/min, again through a capillary the nozzle is reached by the carrier gas carrying the sample compounds.
The nozzle is polarised, from an in built power supply, by a positive voltage of 300 Vdc with very low electrical currents. A metallic ring on the top of the nozzle collect the ionisation current and takes it to the input of electrometer circuit.
An air flow rate of about 250 ml/min, controlled by a third capillary, is supplied to the detector as combustion supporter gas. The quality of the combustion air must be very good (carbon content lower than 0.1 ppm) with the risk of jeopardising the measurements qualities.
Inside the detector are further located a Nickel spiral for the automatic switching of the flame as well as a thermocouple that detects when the flame is **ON** or **OFF** as to command the automatic switching off the hydrogen flow when the flame is **OUT**.

Please note that PID detector is not suitable (accepted) as emission monitoring of VOC at high temperature. PID is a detector suitable to check general hydrocarbon traces.

10.0 FIELD COMMISSIONING AND STARTING UP

1- When starting the instrument it's suggested to keep "Sampling" probe in ambient air as to circulate clean dry air.

2- Connect the plumbing between the cylinder gas pressure reducers and the relevant gas connectors located on the analyser rear panel and indicated as Hydrogen and Air FID. Take care that the pneumatic connections are gas tight, specially for the hydrogen connection. A leakage connection can put the instrument in an unsafe condition as well as cause an abnormal gas consumption.



6mb type connections for 2x1 mm tubings

3- If you have a Calibration Gas Cylinder connect it to the SPAN port.

4- Connect the power cord to the main power supply (220/110 Vac, 50/60 Hz, 300 VA).

5- Connect the heat traced sampling tube to the input of the instrument on the rear panel: "SAMPLE IN".
Take care to connect correctly power supplier to sampling line heating element and check and set the current consumption by adjusting the power supply.

SAMPLE IN with 6x4 mm INOX tubings

6- Switch the Power Switch, **on the rear panel**, in to position ON, now the instrument is on, the display lights and **"warm up"** reading is shown**.**

7- Wait for about 20 minutes for the instrument to heat up and to be properly temperature conditioned.

8- Check that the temperature indicator on the display (electrically heated pump head) reached at least 150°C.

9- Open compressed gas cylinder taps (or generators) and regulate the relevant output pressures of Hydrogen and Air according to data reported in the final check record.

10- The relevant pressure on the manometers located on the instrument front panel, instead, must be set according to the values indicated in the instrument final check card, that goes with each instrument. Please note that the pressure of H_2 is visible just in the condition of **FLAME ON** or the **IGN** push button pressed.

11- Check that manual valve intended for switching VOC/CH4 (if integrated) mode is set to correct modality is selected to use.

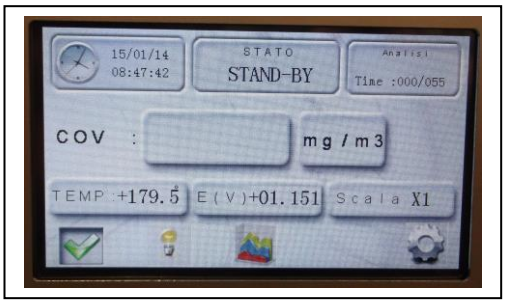
12- Press push switch **IGN and keep it pressed** till relevant indication on the instrument front panel switches to OFF. The operation will take about 20-30 seconds.

13- When FID flame is continuously ON, the indication light located on front panel will stay OFF.

14- Connect output signal, see relevant schematics.

15- In case the indicating light on instrument front panel returns ON (lighting), that means that FID flame is OFF; on the display "**flame alarm**" will be shown.
Please repeat above indicated operations (12-13) till FID flame stays continuously ON (light OFF).

16- Wait till the "**warm up**" indication on the display switches to "**stand by**" indication. This means that the correct working temperature of FID was reached as well as the FID flame is ON.



17- Switch on the sample sucking (attention please never switch ON the pump when the instrument is cool, the PTFE covered pump membranes operate correctly only when heated up, when operated cool it could stuck) see foot note at the end of present paragraph.

18- At this point you may switch ON the sampling pump.
ATTENTION: Never switch On the sampling pump when the instrument is cold, because the PTFE covered heated pump membrane operates correctly just when is heated up. If operated at cold conditions could be damaged and blocked. Please see the below recalled NOTE.

19- As FID flame is continuously ON (light OFF) please wait for some 10 minutes, then set displayed value to ZERO, taking care that instrument sucks clean ambient air (see Chap. 6.0).

20- Insert "Sampling" probe into the stack/duct under analysis.
Now the instrument is regularly working and displaying measured values.

NOTE:

1- The sample sucking pump is PC controlled. Therefore the pump can be activated only when the read temperature is higher than 150°C. It is important to switch on the pump only when the temperature is higher than 150°C. Be very careful in switching on the pump, eventually repeat the operation in sequence different times.

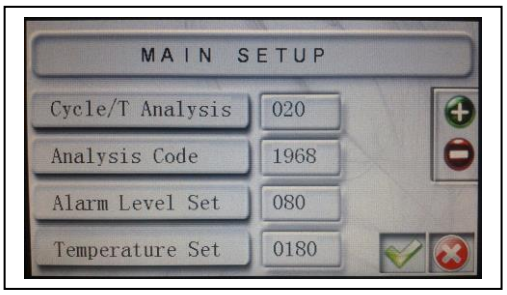
2- FID air consumption is about 200 ml/min. In case the solution with air gas cylinder is chosen as option, please use an adequate UPP gas cylinder (suggested gas cylinder capacity, 5 l).
In case the heated pump does not start up leave the switch on "OFF" position and contact the service people.

10.1 "SET UP" menu

When the monitor is in the "SATND BY" condition the unit may enter into the "SET UP" menu by pressing the push button on the right bottom of the touch screen..

Four options will be allowed:

- T analysis cycle
- Analysis code
- % alarm set up
- T probe threshold



T analysis cycle

This option allows to set the frequency of electronic sampling and memorization of the output signal from FID detector. If this option is selected, while the instrument is under analysis on the up right corner the interval time (seconds) of sampling set will be displayed as well as the system status. The analysis cycles performed are then shown on the display.
If, during the analysis the "NO" push button is pressed the instrument at the end of the cycle enters in "STAND BY"; to restart press "ENTER", the instrument will start again monitoring.

Analysis code

This option allows to assign a code number and/or a name to the analysis that will be performed thereafter. In case an USB pen is introduced in the analyzer for analytical data collection, the relevant files on the USB pen will be identified by the set name or code number.

% alarm set up

This option allows to set the concentration alarm level in terms of % of the selected measuring range of the analyzer. As the measured signal goes over the set threshold a "concentration alarm electrical contact will be closed on the output at the rear of the instrument.

T Probe threshold

It represents the set temperature of the chamber or of the pump heated head.

10.2 Rear panel electrical connections

"Status" signal connector (6 pins)

1 – 2 Flame alarm contact
3 – 4 Concentration alarm contact
5 – 6 Free (temperature alarm?)

"Signal OUTPUT" connector (4 pins)

1	+ 0/4 – 20 mA Analog signal
2 – 3	GND
4	+ 0 - 1 Vdc Analog signal

Please note that, when you select the current analogue signal, the Vdc signal output will be 0-2 Vdc instead of 0-1 Vdc.
You may use such 0-2 Vdc signal to reduce by half your range, in fact if you entre into a signal recording 0 -1 Vdc the 0 - 10 ppm (mg/Nm^3) will be 0 - 5 ppm (mg/Nm^3), 0 – 100 will be 0 – 50 ppm (mg/Nm^3) and so on.

10.3 Monitor "switching OFF" procedure

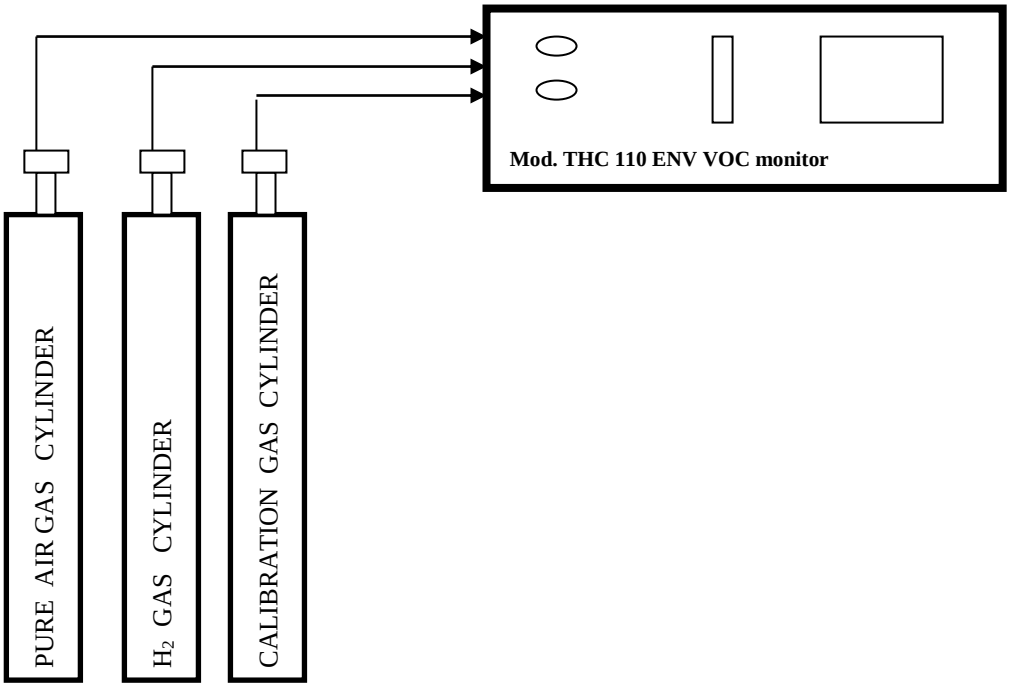
- Extract the sampling probe from the duct/stack
- Leave the monitor to operate for some ten minutes in ambient air (clean and dry sample).
- Close the tap of hydrogen gas cylinder
- Move Pump switch lever on to "OFF" position.
- Move the mains switch lever or the power supply to "OFF" position.

11.0 SUGGESTED PLUMBING

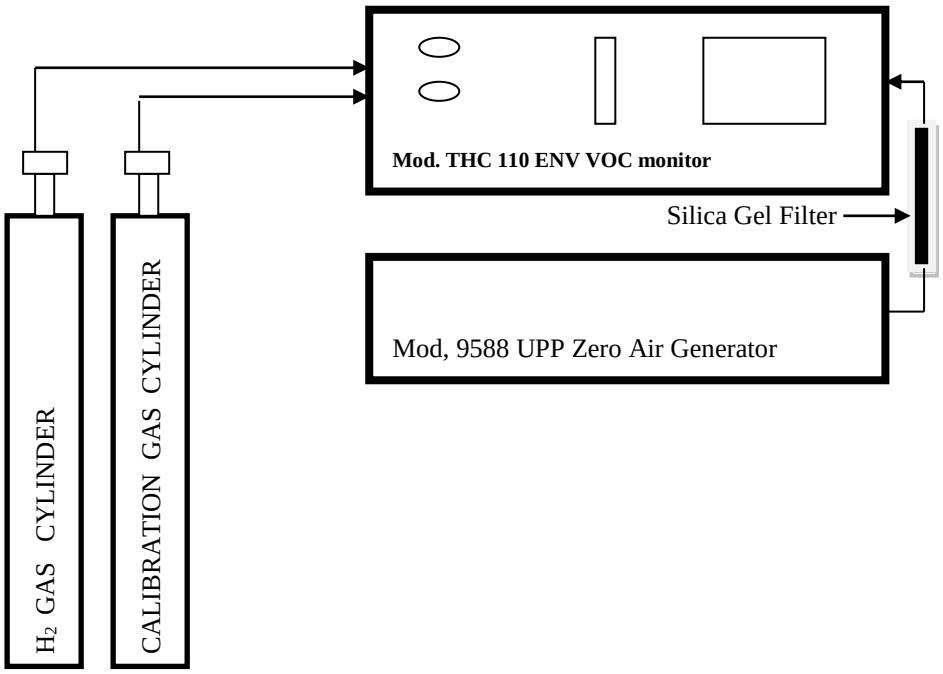
The instrument requires
- hydrogen supply, 25-35 ml/min, as combustible gas of FID detector;
- pure air supply, 180 - 220 ml/min, as supporter of combustion, and carrier gas, the hydrocarbon content must be lower than 0.1 ppm;

The gases can either be supplied by compressed gas cylinders or by pure gas generators. The basic requirements are the purity as well as the supply pressure, high enough to guarantee the gauge set values.

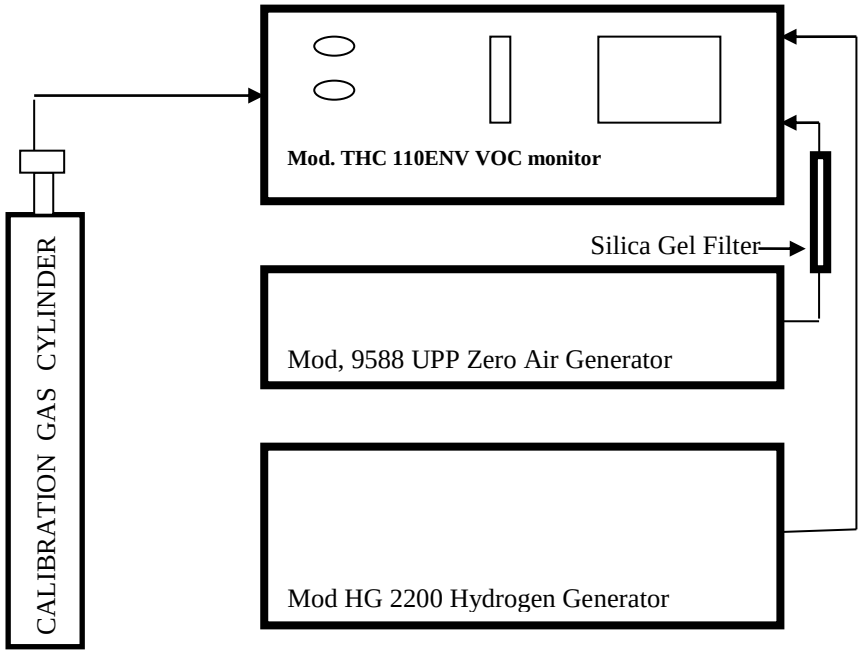
Here below we show the two possible solutions of gas supply, intermediate solutions are also possible, according to the availability in the field or customer's specifications.



Gas Supply from three compressed gas cylinders



Zero Air Supplied by UPP Zero Air Generator (PCF's Mod. 9588)



Zero Air Supplied by UPP Zero Air Generator (PCF's Mod. 9588)
Hydrogen supply by rack mounted H2 Generator (HG 2200)

12.0 MONITOR CALIBRATION PROCEDURES (ZERO AND SPAN)

12.1 Zero calibration procedure.

> **PLEASE NOTE**: in your Mod. THC 110H – ENV the zero is done by switching OFF the sampling pump, no sample in the FID, zero signal through the amplification.

Just stop the sampling pump by the "pump" switch and you will check e regulate the zero of the instrument.

12.2 SPAN calibration procedure

1- Connect the Calibration Gas Cylinder (CGC) to the CAL ort on the rear panel.
2- Switch the Monitoring/SPAN switch on the front panel into SPAN position.
3- You will read the value measured for the concentration of CGC.
4- Adjust the value by the Calibration Potentiometer on the front panel of the instrument.
5- Repeat the procedure from pos. 2 through to pos. 4 a couple of times.

NORMALIZATION

When you calibrate with a mixture of Methane (CH4) in air you read directly in ppm of Carbon.
If you calibrate with a mixture of species different from Methane you should normalize.

Example

Suppose the STD, standard or calibration gas mixture, contains 40 ppm of methane (CH_4) and 10 ppm of C_3H_8 (propane).
We must keep in mind that 1 ppm of propane (C_3H_8) corresponds to 3 ppm of methane (CH_4) as having three carbon atoms in each molecule it produces a response three times higher in the FID detector (FID detector response is approximately proportional to the content of carbon atoms independently from chemical bonding)

Therefore 10 ppm of propane (C_3H_8) are approximately equivalent to 30 ppm of methane (CH_4).
In our calibration mixture we will count 40 ppm methane + 30 ppm equivalent of propane ≅ 70 ppm methane (Carbon) equivalent.
The instrument must be set calibrated to Total VOC ≅ 70 ppm
Or as alternative:

$$70 * \frac{12 \text{ (Carbon Molecular Weight)}}{22{,}414 \text{ (Molecular Volume)}} \cong 37{,}45 \text{ mg/Nm}^3 \text{ VOC}$$

NOTE:

- *whenever the methane (CH4)operating mode is selected by the manual switching valve (TOC/CH4), for the theoretical concentration, the concentration value of propane (C_3H_8) must not be taken into consideration as it is totally converted into CO2 by the catalytic hot scrubber.*
- *The calibration gas cylinder mixture must always be balanced with air, as the nitrogen could produce a lower signal In the FID detector. For emission applications, suggested gas cylinder mixture for calibration is 40 pp of methane (CH4) + 10 ppm of propane (C_3H_8) with air balance.*

6- Once set the signal displayed to the correct calibration (standard) value, close the tap of calibration gas cylinder, then move the “Pompa Sample” switch to “OFF” position.

7- Wait about two minutes then zero the display with ZERO knob potentiometer.

8- Disconnect the T tube for the calibration of monitor from sample inlet and connect to the same inlet the heat traced line carrying the sample gas under measurement.

9- Move the “SamplePump” switch on to “ON” position.

10- Now the monitor is correctly set to perform measurements of Total SOVs.

13.0 MONITOR MAINTENANCE PROCEDURE

All the operations described in the present section must be performed with main power supply to the instrument OFF (disconnect the mains plug) and with the H_2, Air, Span service gases intercepted by the main manometers and valves on the gas cylinders and/or gas generators.

Replacement of sampling pump

- With a spanner disconnect the gas connection to the pump.
- Release the bolts that keep the pump in place.
- Disconnect power supply.
- Replace the pump.
- Fix the bolts and the gas connection.
- Perform a calibration check and eventually adjust the SPAN amplification potentiometer.

Replacement of input high temperature silica wool filter

- With the flat spanners, open the "sample in" block head connector. If the instrument is just switched off wait for the cooling down to about room temperature.
- Replace the high temperature silica wool with the original supplied material. Take care to insert the correct quantity. An excess of wool could cause the clogging of the sample flow.
- With the flat spanners, close the "sample in" block head connector.
- Bring the analyser into measuring mode (again following the standard procedures previously described in this manual) and leave the instrument to work for about an hour without performing any setting.
- Perform a calibration check and eventually adjust the Calibration values. ….

Replacement of FID detector

- With an 8 mm spanner disconnect H2, Air and Sample gas connections. Take care not to spoil the screws and the tightness of connections.
- With a screw driver spanner release the FID block and remove the item.
- Replace the FID with a new one.
- With a spanner block the FID in position
- With an 8 mm spanner connect again H_2, Air and Sample pneumatic connections. Take care not to spoil the screws and the tightness of connections.
- Supply all the service gases and power the instrument.
- Perform a calibration check and control.

Capillary flow rate checks

The check of capillary flow rates is a very delicate operation, therefore it must be performed with the maximum care and attention.

The Capillary flow rates check is performed with the instrument ON and all the service gases connected and pressurised.

To check flow rates a bubble flow meter and/or a digital flow meter must be available.

FID AIR capillary check

By employing an 8 mm spanner disconnect the 2 mm steel tube connected to FID detector through the "AIR" tagged input; then by a soap bubble flow meter and or by a digital flow meter check that flow rate corresponds to the value indicated in the final check table.
In case for the same air pressure the flow rate differs from the reported one in the check table restore the correct flow rate by varying the pressure of FID air operating on the relevant pressure regulator located on instrument front panel. If the correct flow rate cannot easily restored replace the capillary.
When the check is completed connect back the steel tube to FID detector.
In the operation of connecting the steel tube to the FID detector a special care and attention must be given to the correct screwing of the connection in order to both avoid any damage to the thread as well as to have a tight connection.
The tightness of all connection are fundamental for a correct working condition of the instrument.

SAMPLE flow rate check

By employing an 8 mm spanner disconnect the 2 mm steel tube connected to FID detector through the "IN" tagged input; then by a soap bubble flow meter and/or by a digital flow meter check that flow rate corresponds to the value indicated in the final check table.
In case for the same air pressure the flow rate differs from the reported one in the check table restore the correct flow rate by varying the pressure of Carrier air operating on the relevant pressure regulator located on instrument front panel. If the correct flow rate cannot easily restored replace the capillary.
When the check is completed connect back the steel tube to FID detector. In the operation of connecting the steel tube to the FID detector a special care and attention must be given to the correct screwing of the connection in order to both avoid any damage to the thread as well as to have a tight connection.
The tightness of all connection are fundamental for a correct working condition of the instrument.

H_2 flow rate check

By employing an 8 mm spanner disconnect the 2 mm steel tube connected to FID detector through the "**H_2**" tagged input. Then turn in the right direction (clock wise) Px trimmer located on the mother board till the **H_2** interception valve is active (take note of the turns required).
Then by a soap bubble flow meter and/or by a digital flow meter check that flow rate corresponds to the value indicated in the final check table.
In case for the same air pressure the flow rate differs from the reported one in the check table restore the correct flow rate by varying the hydrogen pressure operating on the relevant pressure regulator located on instrument front panel. If the correct flow rate cannot easily restored replace the capillary.
When the check is completed connect back the steel tube to FID detector, rotate Px trimmer located on the mother board (see service manual) to left direction (anti clock wise) of the same turn number till the safety solenoid valve opens again.
In the operation of connecting the steel tube to the FID detector a special care and attention must be given to the correct screwing of the connection in order to both avoid any damage to the thread as well as to have a tight connection.
The tightness of all connection are fundamental for a correct working condition of the instrument.

14.0 SUGGESTED MAINTENANCE SCHEDULE

Basically PCF Elettronica's Mod. THC 110H - ENV Hot FID V.O.C. monitor is a very simple process FID instrument with tested parts to last years without maintenance.
For a good performance in the field it is suggested to commission the instrument since the beginning with the correct gas qualities and pressure as well as to check regularly its working conditions.
For high measuring ranges (> 100 ppm) it is not necessary to have very pure combustion air, dry and compressed ambient air passed into carbon filters will do.

For good maintenance operations of the instrument we recommend:

- standard tool case
- digital multi-meter,
- Strip chart or video graphic recorder (0 - 1 Vdc)
- bubble flow meter with stop watch and/or digital flow meter.

Timing	Operations	Actions (if necessary)
Commissioning	Check: Power Supply Gas Supplies (quality and pressure) Service Gas pressure Analogue output(s)	
Weekly	Sample flow	Replace or clean filters Front filter and/or Sintered filter
Monthly	Sample flow Sintered filter Zero check Calibration check	 If necessary adjust zero by ZERO potentiometer If necessary adjust span by SPAN potentiometer
Every 3 months	Sample flow High temperature Silica wool filter	Check Replacement
Every 6 months	Calibration procedure Sample pump	If necessary change amplification Replace membrane, flappers and tightness o-ring of the pump

Every year	Check H_2 capillary Air capillary Sample capillary Sample pump	 Replace Replace membrane, flappers and tightness o-ring of the pump
Every 3 years	Sample pump	Replace

15.0 TROUBLE SHOOTING

POWER LED OFF	
- Check the mains power supply	Connect power supply
- Check the fuse on the power supply	Eventually replace the fuse
- Thermostatic PCB not working	Replace thermostatic PCB
- Signalling LED broken	Replace signalling LED
- PT100 thermo-resistance open	Replace thermo-resistance
The flame does not ignite **Signalling LED always ON**	
- Auxiliary service PCB not working	Replace auxiliary service PCB
- Lack of Hydrogen or Air	Supply Hydrogen and Air
- Ignition spiral is broken	Replace FID
- Thermocouple is broken	Replace FID
- Clogged H2 or Air capillaries	Check flow rate and replace if necessary
- Transformer not working	Replace transformer
- Wrong hydrogen and air pressures	Set the correct hydrogen and air pressures.
Power LED ON, the others OFF	
- Fuses on power supply PCB broken	Replace fuses
- Stabilised power supply PCB not working	Replace stabilised power supply PCB
Output signals dead	
- FID detector not working	Replace FID detector
- Electrometer board not working	Replace electrometer board
- Auxiliary service PCB not working	Replace auxiliary service PCB
0-1 Vdc signal live **4-20 mA signal dead**	
Check external connection	Restore external connection
4-20 mA board not working	Replace 4-20 mA board

Lack of pneumatic Calibration gas pressure

- Supply cylinder either empty or with closed interception valve	Open the gas cylinder or replace it
- Leakage in the relevant circuit	Find and mend the leakage
- Pressure regulator not working	Replace it
- Manometer not working	Replace it

Lack of FID Air pressure

- Supply air cylinder either empty or with closed interception valve	Open the gas cylinder or replace it
- Leakage in inner relevant circuit	Find and mend the leakage
- Pressure regulator not working	Replace it
- Manometer not working	Replace it

Lack of Hydrogen pressure

- Hydrogen gas cylinder either empty or closed	Either open the air gas cylinder or replace it
- Leakage in pneumatic circuit	Amend the leakage
- Pressure regulator not working	Replace pressure regulator
- Intercepting solenoid valve not working	Replace solenoid valve
- Auxiliary services PCB not working	Replace auxiliary services PCB
- Manometer not working	Replace manometer

No variations on output signals

- FID detector not working	Replace FID detector
- Electrometer board not working	Replace electrometer board
- Output signal board not working	Replace output signal board

No circulation of sample

- Adduction sample line either intercepted or clogged	Restore correct sample flow
- Membrane pump not working	Either replace or repair membrane pump
- Lack of air on air ejector	Replace Mother Board
- Rotation valves not working properly	Replace rotation valves
- Clogging in the analytical circuit	Find and amend the clogging cause and restore the correct flow
- Auxiliary services PCB not working	Replace A.S. PCB

Low calibration values

- New calibration procedure must be performed	Carry out a new calibration
- Sampling capillary partially clogged	Replace sampling capillary.

16.0 SPARE PARTS

PCF's Mod. 110H - ENV , hot FID monitor, spare parts (2015)
Any time a spare part is purchased please supply the description of the part and, whenever possible the type and serial number of the instrument.
Spare parts may include items not mounted in the present version of Mod. 110H - ENV, VOC monitor.

Old Code Number	New Code Number	Description	Suggested consummable parts	Suggested spare parts
09520114	046-0214	Sample capillary	1	1
09520115	090-0211	Hydrogen capillary		1
09520116	090-0212	Air capillary		1
09520120	090-0211	Pressure regulator		
09520121	095-0121	Bar gauge		
09520125	090-0117	FID detector sub assembly		
09520130	09520130	Red LED		
09520131	09520131	Green LED		
09520132	09520132	Return switch		
09520133	09520133	Stable switch		
09520134	09520134	SPAN potentiometer		
095299	046-0102	Data Logger (three analogue inputs)		
09520136	046-0023	Power supply transformer		
09520137	046-0022	Power supply socket		
09520138	09520138	Cooling fan		
09520141	046-0106	Electrometer PCB (module)		
09520143	09520143	Function programming PCB		
09520144	046-0105	Auxiliary services PCB		
09520145	046-0101	Temperature regulator PCB		
09520146	09520146	Stabilised Power Supply PCB		
09520150	09520150	PT 100 temperature detector		
09520152	090-0339	FID detector heating resistance		
	046-4104	Three way manual valve		
	046-4105	Four way manual valve		
09520204	09520204	NMH fraction scrubber		
09520205	090-0341	NMH fraction scrubber heating resistance		
09520206	046-0085	"J" type thermocouple		
09520207	046-0111	Full catalyst replacement		
09514822	09514822	Stainless steel tubing (10 m)		
09514123	09514123	Seal set		
09514124	09514124	Stainless steel pneumatic connections		
09520118	09520118	High temperature SPAN solenoid valve		
09514125	09514125	Fuse set		

09510351	046-0113	Air pump (not heated head) Mod. 502		
09514126	046-0115	Air pump rebuild kit		
064-0105	064-0105	Sampling Pump (heated head) Mod. 5010		
064-0111	046-0114	Heated head pump rebuild kit	1	
09510201	09510201	Hydrogen interception solenoid valve		
09514127	091-3009	Silica wool 10 sets	1	
09514128	09514128	Flame ON temperature sensor		
09514129	09514129	Flame ignition resistance		
09520208	09520208	Zero air scrubber refilling		
09514130	09514130	Mains switch		
09521004	09521004	Sampling probe ceramic filter		
09521011	09521011	Heat traced line/**m**		

Note: whenever you need a replacement item, communicate the S/N of the instrument and, possibly, enclose a picture of the requested item.

PCF ELETTRONICA S.r.l. **VOC MOD. 110H - ENV SERIAL # _____**

FINAL CHECK RECORD

H_2	Gas cylinder pressure …… Bar To FID, flow rate ……..	ml/min
AIR	To FID, flow rate ……..	ml/min
SAMPLE	To FID, flow rate ……..	ml/min

OVEN …… °C

ANALOGUE OUTPUT SETTING 0 - … Vdc

CALIBRATION PARAMETERS

(Calibration mixture used to calibrate the monitor: CH_4 + C_3H_8, air balance)

Gas cylinder: …….. Certification N# …….

Dilution device: THERMO ELECTRON Mod. 146 Dilution system

Traceable
gas mixture: CH_4 _____ ppm VOC _____ mg/Nm^3
C_3H_8 _____ ppm VOC _____ mg/Nm^3

Traceable
gas mixture: Total (CH_4+C_3H_8) _____ ppm VOC _____ mg/Nm^3

Measured
gas mixture: Total (CH_4+C_3H_8) _____ ppm VOC _____ mg/Nm^3

Set point of SPAN: _____Notches
Set point of ZERO: _____Notches

Service Engineer…….. Date:…….

APPENDIX 1 Basic knowledge about FID analysis

A.1.1 The total VOC concept

In the environment as well as at the emissions (stacks) we may find a very large and different number of organic (Carbon) species. The FID detector is the internationally recognized detector that supplies an electrical signal nearly proportional to the quantity of carbon present in the sample under analysis. Actually the FID response is "approximately" proportional to the Total Quantity of Carbon in the sample as different molecules give different signal (not exactly proportional to the carbon atoms quantity in their molecule).

For simplicity sake it is assumed that the FID detector signal is proportional to the mass of Carbon that is ionized in the micro flame. The deviation from this simple rule is due to the presence of oxygen, nitrogen and sulfur atoms as well as of different types of bons between the carbon atoms.

Therefore at the first approximation we may suppose to obtain a signal from FID detector of the following type:

Concentratiom ppm	Compound formula	Commercial name	Carbon atoms number	FID signal
1	CH_4	Methane	1	1
1	C_2H_6	Ethane	2	1,855
1	C_3H_8	Propane	3	2,720
1	C_6H_6	Benzene	6	5,588
1	C_6H_{14}	Exane	6	5,508

A.1.2 The concentrations

The carbon concentrations measure by the FID detector usually are expressed in terms of volume/volume, i.e.

volume/volume => ppmV (parts per million). Conc. in ppmV $= \dfrac{\text{1 volume unit of the species}}{10^6 \text{ unità volume aria}}$

The volume concentrations (as a ration) **do not change** with temperature and/or pressure of the fluid. fluido

The pollutants **concentration** values measured at stacks, in order to be compared with the official legal limits or for being included in statistical calculations, usually are expressed as "carbon mass concentrations".

The mass concentrations must be normalized against temperature and pressure of the fluid, therefore the values of these parameters must be specified.

A.1.3 Measure normalization

The pollutant concentration values at the stacks, in order to be legally employed (comparison with the fixed limits) or for comparison and of statistical calculations, must be normalized.

Normalization: Is the correction from the actual measured concentration value (at known conditions of pressure, temperature, humidity content and oxygen content) to well known and defined reference standard conditions. (e.g. with the fumes in dry conditions, at 0° C temperature, at the 1013 mbar, as well as at a stated reference oxygen concentration). When the fume volume is referred to the NORMALIZED conditions, it is indicated as **m^3_n** or **Nm^3.** The concentrations will therefore be indicated as **mg/m^3_n** or **mg/Nm^3.** While the flow rate will be expressed as: **m^3_n/h** or **Nm^3/h**

Examples:

Volume measures:

We suppose toh ave , as reference (standard) a compressed gas cylinder containing Propane in Air (as indicated in the UNI EN 12619:2013) with a concentration of 20 ppmV, the FID output will be:

$C3H_8$ = 20 ppmV
Actual FID output to Propane = 2,72 * 20 = 54,4 ppmV

The Propane molecule contains 3 carbon atoms; the above reported table gives a FID (experimentally detected) of 2.72 CH_4 equivalent for each molecule of C_3H_8..
As we have 20 ppm concentration of Propane in the gas cylinder, they must be multiplied by 2.72.
if, for instance, the reference standard contained a concentration of 10 ppm of hexane, being the response factor of 5.508 the signal out of FID would: 10 * 5.508 = 55.08 ppm CH4 equivalent.

The calculated measure are expressed in terms of ppm of methane equivalent, because we referred to methane as reference molecule. It is possible to assume a different molecule as a reference, e.g the Propane, therefore expressing the measured values in terms of Propane Equivalent.

Measures expressed in terms of mass concentration:

If you ntend to express the measurements in terms of mg/Nm^3 of Organic Carbon (mg**C**/Nm^3) the following formula must be employed:

$$\textit{VOC Conc} \text{ as mg/Nm}^3. = \text{ppm } \textit{Conc.} * \frac{\textbf{MW } \textit{(carbon Molecular Weight)}}{22{,}414 \textit{ (Molecular Volume)}}$$

Where :

MW = *Molecular Weight **just of the carbon atoms** present in the Molecule of the substance taken as reference in the ppm calibration (according to CEE CEN 264 n. 326 and UNI EN 12619 UNI EN 13526 the reference gas is the Propane).*

ppm Conc. = *ppm concentration of the substance taken as reference in the ppm calibration (in the above recalled example the Methane).*

22,414 = *Molecular Volume -> The Volume of the gas molecule at STP, 0 °C and 101,3 kPa*

Where from we obtain::

$$\textit{Conversion factor } (\text{ppmV - mg}\textbf{C}/\text{Nm}^3) = \frac{\textbf{MW } \textit{(just of Carbon)}}{22{,}414} = 0{,}53$$

If the reference are the ppmV of CH_4, then MW is = the weight of Carbon in the CH_4 molecule.

$$\textit{Conversion factor } (\text{ppmV - mg}\textbf{C}/\text{Nm}^3) = \frac{\textbf{MW } \textit{(just of Carbon)}}{22{,}414} = 1{,}60$$

If the reference are the ppmV of C_3H_8, then MW is = the weight of Carbon in the C_3H_8 molecule.

Here below please find some of the experimentally obtained FID responses.

Organic Compound	*Molecular Weight*	*Relative Sensitivity*	*Response Factor [1]*	*Response against Methane*	*Response against Propane*	*ppm to mg/m³ conversion factor*	*ppm to mgC//m³ conversion factor*
Methane	16.04303	0.99	15.8826	**1.0000**	0.3675	0.7158	0.5359
Ethane	30.07012	0.98	29.4687	1.8554	0.6819	1.3416	1.0718
Propane	44.09721	0.98	43.2153	2.7209	**1.0000**	1.9674	1.6076
Butane	58.12430	1.09	63.3555	3.9890	1.4660	2.5932	2.1435
Pentane	72.15139	1.04	75.0374	4.7245	1.7364	3.2190	2.6794
Hexane	86.17848	1.03	88.7638	5.5887	2.0540	3.8449	3.2153
Heptane	100.2056	1.00	100.2056	6.3091	2.3188	4.4707	3.7511
Octane	114.2327	0.97	110.8057	6.9765	2.5640	5.0965	4.2870
Nonane	128.2598	0.98	125.6946	7.9140	2.9086	5.7223	4.8229
Isopentane	72.15139	1.05	75.7590	4.7699	1.7531	3.2190	2.6794
2,2-dimethyl Butane	86.17848	1.04	89.6256	5.6430	2.0739	3.8449	3.2153
2,3-dimethyl Butane	86.17848	1.03	88.7638	5.5887	2.0540	3.8449	3.2153
2-methyl Pentane	86.17848	1.05	90.4874	5.6973	2.0939	3.8449	3.2153
3-methyil Pentane	86.17848	1.04	89.6256	5.6430	2.0739	3.8449	3.2153
2,2-dimethyl Pentane	100.2056	1.02	102.2097	6.4353	2.3651	4.4707	3.7511
2,3-dimethyl Pentane	100.2056	0.99	99.2035	6.2461	2.2956	4.4707	3.7511
1,1,2-trimethyl cycle hexane	126.2438	0.98	123.7189	7.7896	2.8629	5.6324	4.8229
Cycle heptane	98.18963	1.01	99.1715	6.2440	2.2948	4.3807	3.7511
Benzene	78.11472	1.12	87.4885	5.5084	2.0245	3.4851	3.2153
Toluene	92.14181	1.10	101.3560	6.3816	2.3454	4.1109	3.7511
Ethyl Benzene	106.1689	1.03	109.3540	6.8851	2.5304	4.7367	4.2870
Para Xylene	106.1689	1.00	106.1689	6.6846	2.4567	4.7367	4.2870
Meta Xylene	106.1689	1.04	110.4157	6.9520	2.5550	4.7367	4.2870
Ortho Xylene	106.1689	1.02	108.2923	6.8183	2.5059	4.7367	4.2870
1,2,3-trimethyl Benzene	120.1960	0.98	117.7921	7.4164	2.7257	5.3625	4.8229
N propyl Benzene	120.1960	1.01	121.3980	7.6435	2.8091	5.3625	4.8229
n- butyl Benzene	134.2231	0.98	131.5386	8.2819	3.0438	5.9884	5.3588
Acetylene	26.03824	1.07	27.8609	1.7542	0.6447	1.1617	1.0718
Ethylene	28.05418	1.02	28.6153	1.8017	0.6622	1.2516	1.0718
Methanol	32.04243	0.23	7.3698	0.4640	0.1705	1.4296	0.5359
Ethanol	46.06952	0.46	21.1920	1.3343	0.4904	2.0554	1.0718
n- Propanol	60.09661	0.60	36.0580	2.2703	0.8344	2.6812	1.6076
Iso propanol	60.09661	0.53	31.8512	2.0054	0.7370	2.6812	1.6076
n-Butanol	74.12370	0.66	48.9216	3.0802	1.1320	3.3070	2.1435
Iso butanolo	74.12370	0.68	50.4041	3.1735	1.1663	3.3070	2.1435
sec-Butano	74.12370	0.63	46.6979	2.9402	1.0806	3.3070	2.1435
ter-Butanol	74.12370	0.74	54.8515	3.4536	1.2693	3.3070	2.1435
Methyl-iso-buthyl-carbinol	88.15079	0.74	65.2316	4.1071	1.5095	3.9328	2.6794
1-Hexanol	102.17790	0.74	75.6116	4.7607	1.7496	4.5587	3.2153
1-Octanol	128.21610	0.85	108.9837	6.8618	2.5219	5.7204	4.2870
1-Decanol	154.25440	0.84	129.5737	8.1582	2.9983	6.8821	5.3588
Butyrraldehyde	72.10776	0.62	44.7068	2.8148	1.0345	3.2171	2.1435
1-Eptaldehyde	114.18900	0.77	87.9255	5.5360	2.0346	5.0945	3.7511
1-Octaldehyde	128.21610	0.80	102.5729	6.4582	2.3735	5.7204	4.2870
Decanal	156.27030	0.80	125.0162	7.8713	2.8929	6.9720	5.3588

Formic acid	46.02589	0.01	0.4603	0.0290	0.0107	2.0534	0.5359
Acetic acid	60.05298	0.23	13.8122	0.8696	0.3196	2.6793	1.0718
Propionic acid	74.08007	0.40	29.6320	1.8657	0.6857	3.3051	1.6076
Butyric acid	88.10716	0.48	42.2914	2.6628	0.9786	3.9309	2.1435
Hexanoic acid	116.16130	0.63	73.1816	4.6077	1.6934	5.1825	3.2153
Eptanoic acid	130.18840	0.61	79.4149	5.0001	1.8377	5.8084	3.7511
Octanoic acid	144.21550	0.65	93.7401	5.9021	2.1691	6.4342	4.2870
Methyl acetate	74.08007	0.20	14.8160	0.9328	0.3428	3.3051	1.6076
Ethyl acetate	88.10716	0.38	33.4807	2.1080	0.7747	3.9309	2.1435
Isopropyl acetate	102.13430	0.49	50.0458	3.1510	1.1581	4.5567	2.6794
sec-Buthyl-acetate	116.16130	0.52	60.4039	3.8031	1.3977	5.1825	3.2153
Iso-buthyl acetate	116.16130	0.54	62.7271	3.9494	1.4515	5.1825	3.2153
Acetonitrile	41.05291	0.39	16.0106	1.0081	0.3705	1.8316	1.0718
Dimethyl formamide	73.09534	0.41	29.9691	1.8869	0.6935	3.2611	1.6076
Trimethyl amine	59.11188	0.46	27.1915	1.7120	0.6292	2.6373	1.6076
Ter-Buthyl amine	73.13897	0.54	39.4950	2.4867	0.9139	3.2631	2.1435
Diethyl amine	73.13897	0.61	44.6148	2.8090	1.0324	3.2631	1.0718
Aniline	93.12939	0.75	69.8470	4.3977	1.6163	4.1550	3.2153
Acetone	58.08067	0.59	34.2676	2.1576	0.7930	2.5913	1.6076
Tetrahydrofuran	72.10776	0.76	54.8019	3.4504	1.2681	3.2171	2.1435
Isopropyl ether	102.17790	0.70	71.5245	4.5033	1.6551	4.5587	3.2153
2-Butoxyethanolo	118.17730	0.60	70.9064	4.4644	1.6408	5.2725	3.2153

[1] – response factor = relative sensitivity x molecular weight

APPENDIX 2

A.2.1 Hydrogen safety (very important!)

The combustible gas (H_2) supplied to the instrument must show a 99,999% (in volume) purity.

The highest allowed concentration (impurity) of VOC in it **must not override 0.1 mg/m^3**.
Our Company suggests and supplies, when requested to, 5.5 "Transistor" type Hydrogen,

- purity 99,9995%
- H_2O content < 3 ppmV
- O_2 content < 1 ppm

PLEASE DO NOT SUPPLY H_2 AT A PRESSURE HIGHER THAN THE SUGGESTED ONE :
H_2= 3,0 Bar max.

The care that all the requirements foreseen for the safe use of combustible gases, ly upon customer's responsibility..

Cautions for the use of hydrogen

The Customer must take care that all the hydrogen gas cylinders be according the actual safety norms and requirements, as well as take care of the lodging rooms, of the installation of safety valves that interrupt the hydrogen flow automatically in case of alarm condition, etc.

APPENDIX 3

A.3.1 Entering the Service Menu (very delicate matter!)

Usually the field operator deals with the Main Set up Menu.
If it is necessary to enter (very delicate matter!!) the Service Menu please operate as follows:

i) Switch OFF the instrument then switch it ON
ii) When you have the LOGO of PCF on the screen (see the enclosed picture),
iii) Touch with your finger the center of the screen.

You are in the Service Menu.
Be very careful because the configuration of the same should not be modified

A.3.2 Allowing the downloading of data

As you are in the Service Menu operate as follows:

1. Select the third option: "Parameter set up"
2. On "Data Output" You are faced with two selections: either "Disable" or "Printer"
3. Select "Printer", because if you select "Disable" you do not have any output USB port.
4. Save and exit

A.3.3 Downloaded file

To download the file of data please refer to the info at page 21 of our Mod. 110H (ENV)Operating Manual: MAIN SET UP.

You may chose the frequency of data recording as well as the name of the created file.

i) Write an "ANALYSIS CODE", four digits
ii) The file created on the U disc will be named according to your Analysis Code: XXXX.txt
iii) Bring the U disc to a PC and read the data file with a standard SW, e.g. WORD or EXCEL
iv) The data in the file will have the following format:

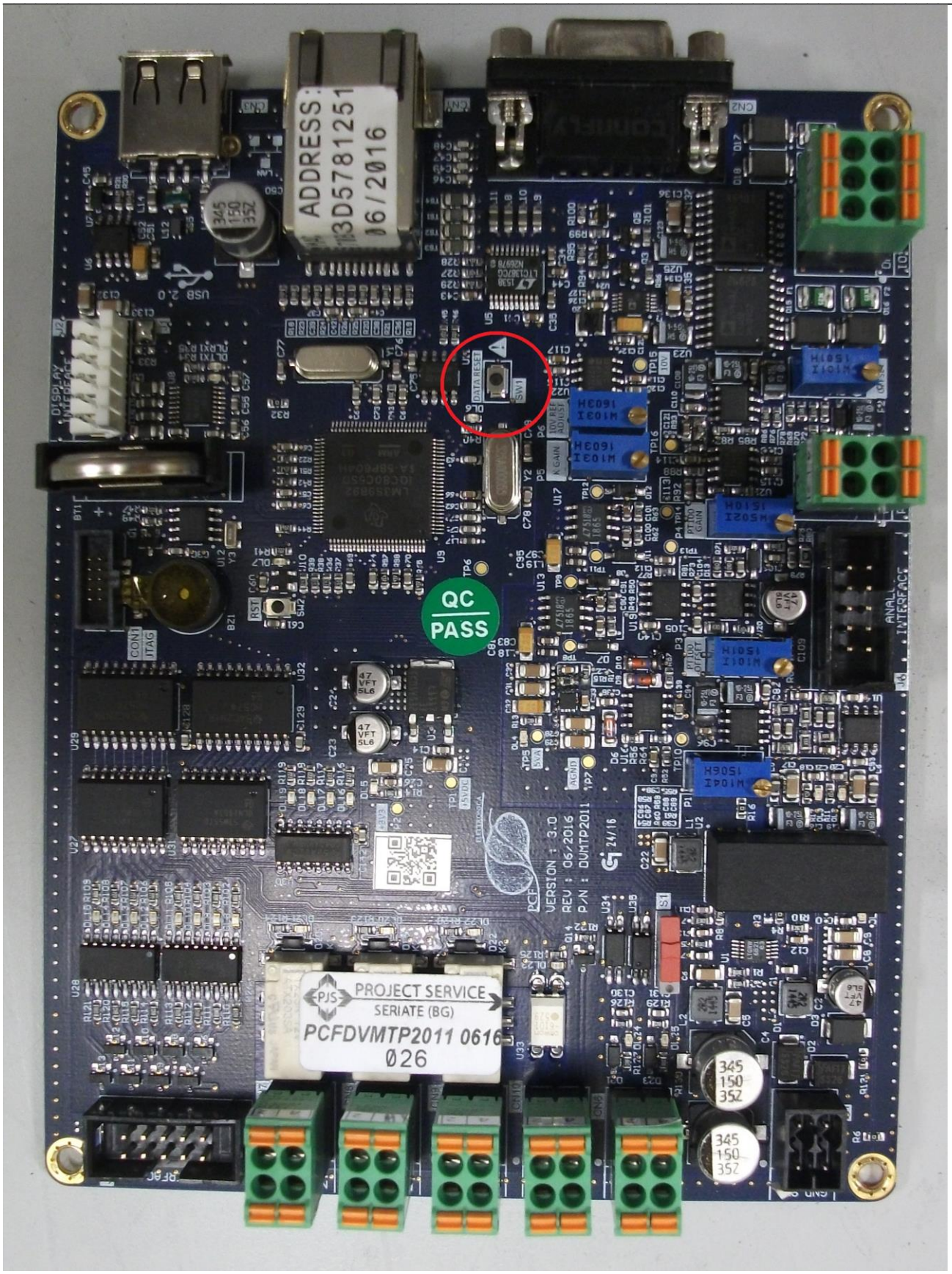
Date	Time	Status	Alarm	Meas. unit	Chan. 1		Chan. 2		Chan. 3	
01/12/2016	15.47	57	0000;005e	ppm	THC	000.59	THC	000.00	THC	000.00

A.3.4 Resetting the touch screen

It could happen that you need to rest the touch screen.
To do the resetting please operate as follows:

1) Switch OFF the instrument.
2) Keep a finger touching the center of the display and the "sw1" switch outlined in red on the main PCB (picture enclosed),
switch ON the instrument.
3) Wait till you do not hear three beeps, afterwards release the center of the screen and the switch on PCB.
4) From now on continue in resetting the touch screen as indicated on the display.

Please operate as indicated, if necessary contact the PCF's Service Dept.
Occasionally you may do a calibration check .
Do not fiddle about with it!!!
Remember that Mod. 110H (ENV) is an industrial instrument intended to operate unattended for long periods.
It is not like a laboratory instrument that frequently needs intervention from the operator!!!


ADDRESS:
3D5781251
16/2016
QC
PASS
PROJECT SERVICE
SERIATE (BG)
PCFDVMTP2011 0616
026
VERSION : 3.0
REV : 06/2016
P/N : DVMTP2011


Press The Cross Dot In Left_Top
Press The Cross Dot In Right_Top
Press The Cross Dot In Right_Bottom